Calorimeter Fast Sim Update

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Outline

- Motivation

- Method I: Integrated EMCal and HCal

- Method II: Separate EMCal and Hcal

- Parameterizations

Motivation

- Testing different tracker configurations and observe large fake rate when using ganged output in strip layers (expected)

- Want a fast sim of the calorimeters
  - Need some idea of how calorimeter-track matching will improve purity in high multiplicity events
  - Full GEANT4 sim is too cumbersome to test many configurations

- Open questions
  - What level of realism is necessary?

Method I: Integrated EMCal and HCal

- Model whole calorimeter as a "blackhole" cylinder in place of the EMCal
  - Particles leave a single hit, deposit all energy, and are killed
- During tower building phase, smear detector response as a function of truth energy, rapidity, and particle species
- Smearing calculated from parameterizations developed from single particle full GEANT4 simulations
- Pros:
  - Quick and easy
- Cons:
  - Cannot implement different segmentation as in EMCal vs Hcal
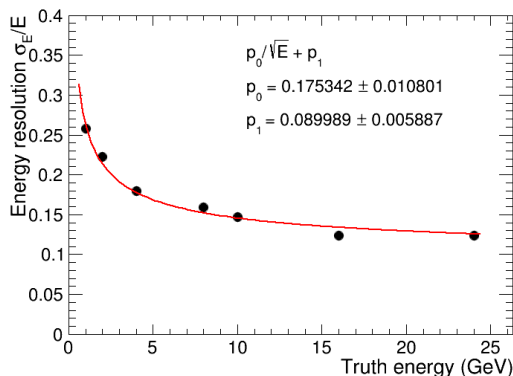 - No electron-separation (Upsilons)

Method II: Separate EMCal and HCal

- EMCal is a thin cylinder of gas at radius of EMCal
  - Particles pass through and leave hits but don't shower
- Hcal is a "blackhole" cylinder at radius of Hcal
- During tower building phase…
  - Loop over the hits each EMCal tower, determine deposited energy
  - Loop over hits in HCal towers, subtract off energy from EMCal, smear remaining energy
- Pros:
  - Could be more realistic
  - More parameters to tune
- Cons:
  - Much more complex (room for error)
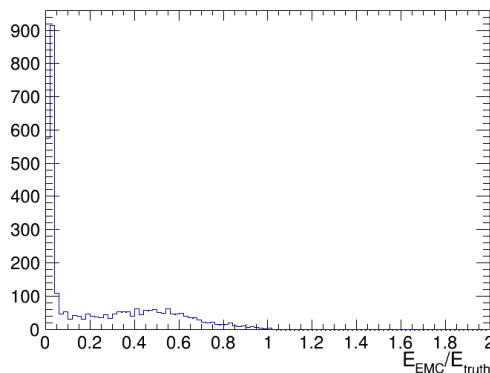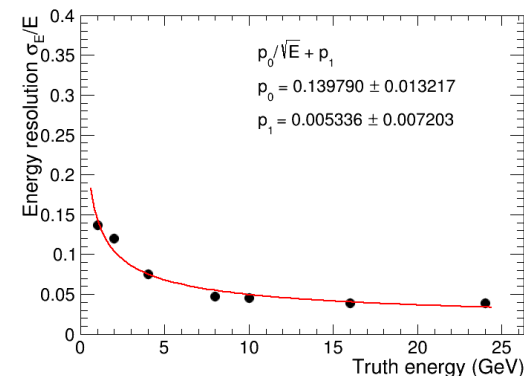 - Need to understand EMCal-HCal correlations

Parameterizations

- Making functional parameterizations based on full simulations

$$p_0/\sqrt{E} + p_1$$
$$p_0 = 0.175342 \pm 0.010801$$
$$p_1 = 0.089989 \pm 0.005887$$

$$p_0/\sqrt{E} + p_1$$
$$p_0 = 0.139790 \pm 0.013217$$
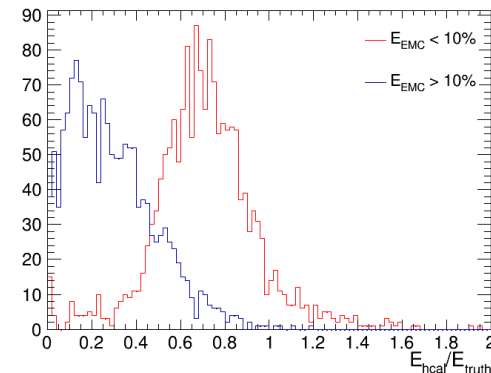$$p_1 = 0.005336 \pm 0.007203$$

- This gets complicated if EMCal and HCal are separate

Single pions

Single pions

- Library of pre generated showers?

Conclusions & Questions

- Starting with easiest method---black hole for full calorimeter system
  - Thoughts on validity? Reasonable as a starting point?
- Second method---emc and hcal separate
  - Is this important for the present study?
  - Eventually yes---e/h separation (?)
- Additional questions
  - Spreading energy to towers surrounding the central one is important for understanding occupancy effects
    - Any suggestions for how to approach such a parameterization are welcome
  - How about the look up table? Seems like it could be a lot of work for a level of detail that's not needed, but we definitely seek input from the experts